Consequences of COVID-19 on the Social Isolation of the Chinese Economy: Accounting for the Role of Reduction in Carbon Emissions

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Abstract: The main contribution of the present study to the energy literature is linked to the interaction between economic growth and pollution emission amidst globalization. In contrast to the existing studies, this research explores the effects of economic and social isolation as dimensions of globalization. This allows underpinning the effects on the Chinese economic development of the isolation phenomenon as a consequence of coronavirus (COVID-19). To this end, annual time frequency data is used to achieve the hypothesized claims. The study resolutions include (i) The existence of a long-run association between the outlined variables (ii) The long-run estimates suggest that the Chinese economy over the investigated period, is inelastic to pollutant-driven economic growth as reported by the dynamic ordinary least squares, fully modified ordinary least squares and canonical regressions with a magnitude of 0.09%. (iii) The Chinese isolation is less responsive to its economic growth while the country political willpower is elastic as demonstrated by current government commitment to dampen the effect of the COVID-19 pandemic. This is marked by the aggressive response by the government officials resolute by flattening the exponential impact of the pandemic. Based on these robust results some far-reaching policy implication(s) are underlined in the concluding remark section.

Keywords: Economic growth; COVID-19; CO_2 emissions; Isolation; Globalization; China

1. Introduction

Only a decade ago, the global economy has made some efforts to recover from the Great Recession, where globalization played an important role in the scale of the crisis. In 2019, Asia was the engine of the global economic growth, wherein China and India counting with the highest growth rates (IMF 2020). However, recently both IMF and OECD revised down projections for 2019 and 2020. In the case of China, an ongoing structural slowdown is underlined despite its growth rate close to 5% (OECD 2020). Like majority of the economies, China is largely integrated globally (OECD 2020). Additionally, the Chinese economy is a major commodity importer and by taking advantage of the globalization phenomenon, it became the largest manufactory exporter.

However, the evolution of the world economic growth is linked to the evolution of Asian economies, mainly the Chinese economy. Thus, the outbreak of a new coronavirus (COVID-19) in China in December 2019 has led to spreading the virus not just at national level, but also around the globe. Given the speed and scale of the COVID-19, the effects go far beyond mortality (Fernandes, 2020). Under the declaration of the pandemic crisis, China, followed by many other economies, had to isolate both socially and economically through severe lockdowns. The effect over consumption and production were foreseen up to a point, but, overall, the global supply chain has been disrupted. Like in previous outbreaks, the impact of COVID-19 might provoke an economic crisis (Keogh-Brown and Smith 2008), which is expected to be a lot more dramatic than the one caused by SARS (OECD 2020). The economic confidence in the Chinese economy has decreased and seems to intensify financial stress (OECD 2020). Thus, it is expected to affect the economic growth as well as trade activity (Leiva-Leon et al. 2020), which are closely linked to globalization, energy consumption and CO_2 emissions.

Globalization, a driven force for international economic integration and development, is declining in China as well as in other economies linked with China not just due to the COVID-19 infection, but also due to the economic consequences of the outbreak. Industrialization, social interactions, and tourism are also put on hold, and restricting these activities is expected to cause a decline in globalization and its impacts. Additionally, change in trade patterns is one of the challenges to be faced lately by the industry. This problem is even more intense in the case of China, which a net exporter with high dependence on the imports. In fact, China is a major importer of commodities (OECD 2020), especially from Africa. However, with the outbreak, China is experiencing considerable reduction in consumption and production, as well as in trade.

Consequently, the COVID-19 outbreak and the need of lockdowns have led to a decrease in energy consumption. The economic and industrial activities have been put on hold, and therefore, a drastic reduction in energy consumption is experienced, followed by reduction in CO_2 emissions. The mitigation of trade, as a proxy of globalization, under the current context is also expected to be linked with the energy consumption (Solarin et al. 2016). Since the increase of globalization in China and its consequent entrance into World Trade Organization at the beginning in 2001, the Chinese economy started to develop faster due to considerable increase of its exports. This move put China as the leader not just in manufacturing trade, but also among one of the earliest economies to have sustained positive current account balance.

With the outbreak and spread of COVID-19, Chinese trade started reducing drastically due to bans imposed by many countries on business and social activities with China. Moreover, steps taken to curb the spread of COVID-19 have led to 15-40% reductions in output across different sectors, which might have reduced at least a quarter of the country's CO_2 emissions in the past two weeks, the period within which activities would normally have resumed after the Chinese new-year holiday.

Over the same period, the COVID-19 could have cut global emissions by 100MtCO_2 to date (see Figure 1; Figure 2), while China released around 400 m tons of CO_2 (MtCO_2) in 2019. Whether the impacts of CO_2 emissions are diminished or reversed along with the government's response to the crisis is among the main aspects to consider. In fact, COVID-19 could cut 50% of global oil demand in January-September 2020 (IEA 2020; OPEC 2020). Under the crisis scenario, the Chinese government's policies and strategies, aimed to curb the disruption caused by COVID-19 outbreak may balance these short-term impacts on energy and CO_2 emissions, the same way as was the case in the global financial crisis (GFC) and the internal economic slowdown in 2015.

<INSERT TABLE 1>

<INSERT FIGURE 1>

<INSERT FIGURE 2>

The negative impact of the COVID-19 outbreak on energy consumption pattern will lead to a reduction in the emission of CO_2 emissions, as reported in the recent study of Zambrano et al. (2020). Decline in CO_2 emissions in developed countries can also be said to be a consequence of the rise in services and information-intensive industries, instead of high-energy intensive and carbon-intensive industries (Huang et al. 2018). Before COVID-19 lockdown, we expected global CO_2 emissions to be similar to those in 2019, so the effect of confinement on CO_2 emissions might be approximately equivalent to the change from 2019 emissions (Le Quéré et al. 2020).

The present study seeks to further analyze the impact of COVID-19 outbreak over the Chinese economy. Hence, this study aims at determining the impact of the cut-offs of carbon emissions on Chinese economic growth during confinement. In doing so, carbon emissions are

assumed to be dirty inputs. The lack of data implies adopting a strategy based in the study of stochastic process and elasticity, following a cointegration framework. These allow predicting the current situation and might be a proper tool for policymakers. Hence, econometric tools are used to determine the degree to which carbon emissions impact over Chinese economy and if the reduction in emissions levels will induce a reduction in income levels. Thus, the present study aims to identify warning signs, as well as projecting the impacts of changes in carbon emission and globalization on the Chinese economy.

While carbon emissions and their implications are considered in previous literature for testing the Environmental Kuznets Curve (Sidneva and Zivot 2014), the present study assumes carbon emissions as a dirty input and looks for how stationarity trend of carbon emissions helps to predict the adoption of new regulations. Furthermore, the study of Gil-Alana and Solarin (2018) outlined the variances between a trend and difference stationarity data generating process (DGP), which aid in ascertaining the possibility of long-run effects as it concerns environmental blueprints. As such, these approaches rely on projection of forward pollutant emissions and affirming precision of the forecast. Additionally, in the econometrics literature, dealing with stable and non-stable series, the long-term properties emanate from its deterministic trend components. A series containing unit root generates uncertainty in long-term, while stationary (stable) variables are free of uncertainty in DGP. On the contrary, modeling with non-stationary variable possess traits of uncertainty.

Two approaches are proposed for the Chinese economy: (1) examining the stationarity properties of the CO_2 emissions by both traditional and novel Fourier ADF-GLS, LM unit root test, (2) the linkage between economic growth and carbon emissions, under a globalization setting. Empirical outcomes might help policymakers on whether they should implement environmental restrictions, leading to reduction in carbon emissions, or allow economic activities

to automatically address the pollution control, and (3) cointegration is considered a suitable technique in this context based on the provision for elasticities to induce the impact of carbon emissions over economic growth in China since December 2019, after confirmation of the first case of COVID-19 in Wuhan. This will ensure more flexibility in the dynamic specification of the model. Furthermore, by considering globalization, additional information about the nature of the shocks is included. Transitory isolation of the Chinese economy, both economic and social, as components of globalization, must be considered for approximating to the real situation.

The structure of the paper is as follows: second section is focused on review of literature, third section is dedicated to presenting dataset and methodology, while the results of the analyses are presented in the fourth section. The fifth section compiles the discussion of the findings, while the final section provides conclusions and policy recommendations.

2. Literature Review

Limited studies exist on the stationarity assessment of carbon emissions. Studies by Aldy (2006) or Lee and Chang (2009) have explored the carbon emissions movement of the developed and industrialized countries and non-stability of the developing countries was assessed through the stationarity testing procedure proposed by Carrion-i-Silvestre et al. (2009). Aiming to check the convergence hypothesis, stationarity properties of the carbon emissions were tested by different authors (e.g., Romero-Avila 2008; Ahmed et al. 2016). Christidou et al. (2013) applied a nonlinear panel unit root test confirming the stationary for 33 nations during 1870–2006.

On the other hand, there is an impressive entirety of papers that provide the proof for the non-stationary of carbon discharges (Criado and Grether 2011). Different investigations confirm that carbon emanations follow unit root process (Li and Lin 2013; Presno et al. 2018). In accordance with these outcomes, Jaunky (2011) demonstrated that CO_2 emanations for high-

earning nations are integrated with order one. Yamazaki et al. (2014) indicated that in the OECD countries, per capita CO_2 emissions follow unit root. Barros et al. (2016) applied fragmentary combination for the global series of carbon discharges and arrangement of every one of its five segments (gas, fluids, solids, concrete creation and gas flaring). The observational outcomes indicated that the arrangement is non-stationary with the integration order fundamentally over 1.

Furthermore, on the literature trajectory between globalization, energy consumption and economic growth, a number of studies found the relationship between globalization, energy consumption, and economic growth (see Solarin et al. 2016; Alola et al. 2019; Wu et al. 2019). However, studies have largely ignored various aspect of globalization, i.e. political globalization, social globalization, and economic globalization. Solarin et al. (2016) discovered that there exists a positive correlation between globalization and energy consumption in the long-term. Energy consumption, urbanization, financial development, and economic growth have positive effects on emissions, in presence of globalization. On the contrary, openness to trade, foreign direct investment, and innovation have exhibited negative impacts on emissions, as reported by Khan and O'Keefe (2017). Furthermore, Alola et al. (2019) show that energy consumption is strongly related to globalization in the long-run, while adopting the Auto regressive distributed lag approach. Tourism can be considered a form of social globalization, which promotes CO_2 emissions in both the short and long term, while the real income and level of globalization promote CO_2 emissions only in the long term. Thus, ensuring sustainability of global energy utilization, it is pertinent to shift from import oriented economies to export based economies.

Additionally, export oriented and developing economies, such as China, need to adjust trade pattern so as to ensure economic and ecological competence in the global market, aside improving production efficiencies (Wu et al. 2019). As energy is an important factor for economic growth, its conservation may harm growth pattern (Ouedraogo 2013).

Furthermore, tourism exposure, as consequence of globalization process, and the amount of energy consumed are in long-run equilibrium relationship with CO_2 emissions. Development of tourism has led not only to considerable increase in energy use, but also to climate change, (Katircioglu 2014, 2020). Energy consumption, level of real income/output, and globalization play important roles in achieving environmental sustainability. Trade openness leads to increase in globalization, while having an inverse impact on pollution (Akadiri et al. 2019).

While considering the effects of carbon emissions associated with consumption of electricity from nonrenewable sources, Apergis and Payne (2012) found a unidirectional causal relationship between economic growth and renewable electricity consumption in the short-run and bidirectional causality between them in the long run. Secondly, there exists a two-way causal relationship between nonrenewable electricity consumption and economic growth both in the short- and long run. Economic growth has a positive and statistically significant effect on energy consumption in the short run. An increase in real GDP is likely to affect energy demand, since energy is a major input in the production process (Ouedraogo 2013; Raza et al. 2018). Finally, there is a positive correlation between globalization and energy consumption in the long-term (Solarin et al. 2016).

It is pertinent to know that after the review of literature, no study has looked at the influence of the COVID-19 outbreak on energy consumption, economic growth and globalization. This is what this study is aimed at investigating.

3. Empirical Methodology and Data

Over the last decade, the Chinese economy has been plagued with air pollution (Zhang et al. 2014) due to heavy industrialization and anthropogenic activities. To this end, the present study attempts to validate a direct relationship between economic growth and carbon emissions

in China between 1981-2014, in order to establish the elasticity relationship between carbon emissions and economic growth for policy formulation. We also explore the impact of economic, social, and political globalization on economic growth, and the effect of confinement, isolating both economic and social globalization. We assume that carbon emissions exert as dirty input (Emir and Bekun 2019) exert a direct impact over economy growth. In other words, we expect to confirm that rising carbon emissions will lead to ascending economic growth (Balsalobre et al. 2020) to determine the elasticity relationship between these variables and induce the impact of reduction in carbon emissions on economic growth in China during 2020 confinement. With the objective of strengthening the model towards a closed economy, the empirical model proposes the omission of the economic and social globalization variables, which are more related to the movement of people, businesses, intermediate goods and raw materials.

On the premise of the highlighted literature, present study is also motivated by the campaign of United Nations Sustainable Development Goals (UN-SDGs- 3, 8 11, 13, and 17) that borders around sustainability, good health, economic expansion, climate change mitigation issues, and global partnership in the context of our study. The SDGs informed the construction of variables adopted for the econometric analysis and subsequently, the following hypotheses were presented to properly tie study aim:

H1: There is a direct connection between per capita CO_2 and per capita GDP in China.

The present study seeks to underpin, if economic activities in a highly industrialized nation (China) trigger pollution emission. Although, several studies have validated the relationship (Adedoyin et al., 2020) without considering interconnectedness of countries. This led to the construction of the next hypothesis:

H2: There is a direct linkage between globalization and economic growth.

According to the UN-SDG-17 that outlined the role of partnership for sustainability, the present study seeks to understand the directional nature of connection in a co-integrated framework for China.

H3: The economic and social isolation, as a consequence of the COVID-19 pandemic of 2019, present an adverse effect over the Chinese economic growth. This hypothesis confirms UN-SDG-3, where the emphasis is placed on sustainable health for national prosperity. In the context of the global pandemic for the case of China, this study seeks to understand the effect of social isolation and its implications on economic growth while considering health status.

We propose two models (Equ. 1, and Equ. 2), as follows:

$$LGDP_t = \alpha_0 + \alpha_1 LCO2_t + \alpha_3 LEG_t + \alpha_4 LSG_t + \alpha_5 LSP_t + \varepsilon_{it} \quad (1)$$

Equation 1 contains $LGDP_t$ (logarithm of per capita gross domestic product) and $LCO2_t$ (logarithm of per capita carbon emissions; World Bank database 2020) considered as dirty input to investigate the relationship between these variables. Equation-1 also includes the economic LEG_t, social, LSG_t, and political LPG_t globalization (KOF 2020).

Our main model (Equation-2) represents a model where we isolate the effects of both economic and social globalization, to understand the events of closed country assumed for Chinese Administration during COVID-19 crisis:

$$LGDP_t = \alpha_0 + \alpha_1 LCO2_t + \alpha_5 LSP_t + \varepsilon_{it} \quad (2)$$

An important aspect of this study is to validate, if there is a decoupling that varies over time and therefore invalidates the long-term predictions. To do this, we first analyze the processes and stochastic properties of the variables used. In consequence, we need to analyze stationarity properties of the selected variables to formulate long-term policy implications. In time series analysis, changes in a model parameter in temporal stationarity signifies that variance and average are constant. In consequence, we assume that, when a model parameter alters its individual projected value like its mean and thus, policy-level shocks have no permanent consequence on them, and those shocks are not sturdy. But, in case a model parameter

demonstrates non-stationarity, policies leaning towards adopting that parameter will be effective (Nelson and Plosser 1982; Perron 1989). Consequently, policy-level standpoint requires to be deliberated with respect to tenure of the effect.

In the incidence of stationarity, every policy shock needs not to endure transitory impact, or they might not prove to be impactful. Fleeting policies (the ones to alter the capacity of applicable model parameters) will be likely to demonstrate individual momentary impacts. Perpetual fluctuations consequently call for a more enduring policy-level standpoint in a condition of this kind. Conversely, in the incidence of non-stationarity, momentary shocks will demonstrate perpetual impacts (Belbute and Pereira 2017).

The present study follows this methodology, if unit root analysis is suitable for checking stationarity properties of the series and in consequence it would disclose suitable policy recommendations. Even traditional unit root tests: ADF test (Dickey and Fuller 1981), PP test (Phillips and Perron 1988), KPSS test (Kwiatkowski et al. 1992), DF-GLS test (Elliott et al. 1996), or NP test (Ng and Perron 2001) follow their own test procedures; these tests are likely to assent to the null hypothesis that is largely grounded on presence of unit root, while the model parameters contain structural breaks (Perron 1989). Another unit root tests by Lee and Strazicich (2003) recommend a bi-break lowest Lagrange multiplier (LM) unit root test, with alternative hypothesis unequivocally inferring trend stationarity.

Furthermore, Zivot and Andrews (1992) (ZA) and Lumsdaine and Papell (1997) (LP) unit root tests ponder upon the same number of structural breaks. In addition, ZA and LP undertake no breaks as null hypothesis, while stemming the critical points. Accordingly, alternative hypothesis signifies the persistence of structural breaks, though model parameters might demonstrate non-stationarity. Consequently, LM test permits breaks and deliberates the occurrence of unit root, where, ideal count of breaks is endogenously governed. Hence, LM test

outcome is more agreeable in the incidence of two structural breaks. In econometric literature we also find a variant of Gallant's (1981) Flexible Fourier Form, Enders and Lee (2012a, 2012b) or Rodrigues and Taylor (2012) who propose Fourier unit root test, where, rather than choosing explicit break periods, their count and arrangement, the measurement issue is transmuted into slotting in the applicable frequency modules within the empirical model (Enders and Lee 2012b).

So, Fourier unit root tests count on estimations, while deliberating deviances from the average in measurable expressions by means of trigonometric expressions. In the pursuit, Enders and Lee (2012a) applied LM regression, which was originally promoted by Schmidt and Phillips (1992). On the other hand, Rodrigues and Taylor (2012) opted for GLS regression based on Elliott et al. (1996), while Enders and Lee (2012b) employed Dickey and Fuller (1981) regression. Consequently, these estimation procedures will be recognized as Fourier LM, Fourier GLS, and Fourier ADF, correspondingly. Once we have checked the stochastic properties of the proposed variables in order to be allowed to establish long-run policy recommendations, the major aim of this paper is to estimate the emissions-GDP elasticities (Cohen et al. 2018), in order to establish a robust patter for considering how the reduction in emissions will infer over economic growth, via long-run elasticities. Cohen et al. (2018) used the standard decomposition cycle or trend used in many other fields of economics. A panel cointegration model was used by Narayan and Narayan (2010) to evaluate elasticities of emissions in the short and long-run as regards the developing economies' output.

Fisher-Johansen's cointegration test (1991) joins separate estimation procedures, while associating estimation procedures from distinct cross-sections. Π_i is the p-value of a specific cointegration module for cross-section i. Null hypothesis for the panel thus turns out to be:

$$-2\sum_{i=1}^{N}\log\left(\Pi_i\right) \rightarrow \chi^2 2N \qquad (11)$$

χ^2 values are built upon MacKinnon-Haug-Michelis (1999), and *p*-values are calculated by Johansen's cointegration trace and maximum eigenvalue tests.

FMOLS (Fully Modified Least Squares) and the DOLS (Dynamic Ordinary Least Squares) are used for validating the hypotheses. These methods can tackle the endogeneity and serial correlation issues. They are also effective for samples with lesser size by disregarding inaccuracy caused by sample bias (Narayan and Narayan 2005).

4. Empirical Results and Discussions

This section presents the study's empirical results and subsequent interpretations accordingly. The sections seek to put to perspective the hypothesized study claim highlighted in section 3. These sections proceed with test of variables stationarity properties and subsequent tests accordingly.

<INSERT TABLE 2>

<INSERT TABLE 3>

As the starting point of the analysis, we have analyzed the unit root properties of the model parameters, and in this pursuit, we have employed the DF-GLS, ADF, and LM unit root tests, and the test outcomes are recorded in Table 2. The test outcome divulges that the model parameters are stationary after first difference, and thereby indicating their order on integration to be unity. However, these tests are cannot produce robust outcome in presence of unknown structural breaks, and therefore, we have employed Fourier unit root test, the outcome of which are recorded in Table 3. The outcome of Fourier unit root test divulges that the model parameters are integrated to unit order in presence of structural breaks.

From empirical results, we can induce that selected variables can be used for predicting long term effect. In consequence, the stationarity properties of carbon emissions determine that policies will be effective or not. Our study also presents limitations, as we are not considering the technical effect (Alvarez et al. 2017) and the effects of renewable energy use. However, this study focuses on the elasticities of carbon emissions-GDP association, and how the absence of globalization infers over this relationship. In consequence, our empirical results (Table 2 and 3) may be misleading to make policy recommendations, if we only consider carbon emissions-economic growth consequence. For that reason, we also consider the effects of economic, social, and political globalizations, and absence of economic and social globalization caused by socio-economic isolation imposed by the Chinese authorities as a result of the COVID-19 outbreak.

Subsequently, we have obtained evidence of a long-term relationship that allows us to make recommendations that are more than temporary in nature. The next step is to estimate the connection between carbon emissions and economic growth through cointegration. In order to proceed, we need to confirm the long-run relationship between proposed variables though cointegration tests and the test outcomes are recorded in Table 4.

INSERT TABLE 4

After ascertaining the long-run association among the model parameters, there different test were applied: Fully Modified Ordinary Least Squares (FMOLS) suggested by Phillips and Hansen (1990), Dynamic Ordinary Least squares (DOLS) proposed by Saikkonen (1991) and Stock and Watson (1993), and Conical Cointegration Regression (CCR) based on Park (1992). This battery of tests is capable of endowing us with the consistent and robust test outcomes, given the small volume of data. FMOLS outcomes are robust in presence of serial correlation and endogeneity, which might be arising out of the probable cointegrating association among the

model parameters (Phillips 1995), whereas DOLS allows the elimination of possible feedback persistent in the cointegrating association among the model parameters.

In Table 5, the results of causality analysis are presented, that highlight the degree of predictability of each variable on another. The result shows one-way causal relationship between economic and social globalization and CO_2 emissions. This suggests that economic and social integration with the rest of the world drives CO_2 emissions over the sampled period. However, there is a deviation since December 2019, after the first case of the COVID-19 was reported in Wuhan. Theses translate into low emissions level over the recent months. This outcome resonates the novel and recent findings of Zambrano et al. (2020). However, this finding has further impact given the isolation of China from the rest of the world to ameliorate the health issues, which also have its environmental implication. These revelations are suitable for proper policy contrition with synergy with other macroeconomic indicators of China. Further insights on causality results are highlighted in Figure 3.

<INSERT TABLE 5>

<INSERT FIGURE 3>

<INSERT TABLE 6>

Table 6 shows all the values obtained from the FMOLS, DOLS and CCR estimations for the proposed equations 1 and 2. The empirical results confirm direct connection between selected explanatory variables (CO_2, EG, SG, PG) and economic growth (LGDP), while Equation 1

considers globalization process, and in Equation 2, we omit the impact of economic and social globalization (we considered that political globalization is maintained during COVID-19 crisis).

The outcome of Equation 1 and 2 across three methodological procedures demonstrate that CO_2 emissions have a direct impact on the GDP. If we compare both models, we can observe that when we isolate the effects of both economic and social globalization, connection between carbon emissions and economic growth is higher (0.099766), and even the explanatory power of the adjusted R^2 has been reduced (Figure 4). The major concern, however, is to find the nature of relationship between GDP and CO_2 under an isolation scenario, which explains that an increase in 1% of carbon emissions (considered as dirty input) (Balsalobre et al. 2020) will increase economic growth a 0.09%. This implies that the Chinese economy is inelastic to economic growth in presence of economic and social isolation. Interestingly, the long run regression of DOLS, FMOLS and CCR all resonates higher magnitudes of impact of political willpower of dirty economic relative to model (1) with the interaction with rest of the world by the incorporation of economic and social dimension of globalization as reported in Table 6.

These results suggest that, the Chinese economy does not response to pollutant emission over the sampled period. This outcome resonates the study of Emir and Bekun (2019) for the case of Romania. Table 5 reports the causality analysis over the outlined variables. We see a uni-directional causality running from economic globalization to CO_2 emissions. Similarly, one-way causality is observed between social globalization and CO_2 emissions, while no causality is seen between political globalization and CO_2 emissions. These results help us understanding the predictive power of one variable over another. We observe that both social and economic interaction of economics response to increase in pollution economy while political willpower is crucial to mitigating pollution economy, which has been demonstrated in the current study as no

causal interaction is seen between economic growth and CO_2. The plausible explanation could be the current disposition of the Chinese economy to be insulated from the rest of the nations.

INSERT FIGURE 4

5. Conclusion and Policy Implications

In more recent times, the world has experience diverse uncertainties ranging from the great depression in 1930's, global food crises of 2006 to global financial crisis (2008-2009) to the very recent pandemic of COVID-19, which stem from Republic of China at Wuhan. As an extreme event, the outbreak of COVID-19 has damaged the global economic growth generating a certain impact on the environment. The COVID-19 pandemic has radically altered patterns of energy demand in both China and around the rest of the world. Current estimations have estimated the decrease in CO_2 emissions during forced confinements. These mentioned uncertainties have ripples effect of socioeconomic and Macroeconomic indicators of any nation. Thus, this present study focuses on Republic of China given the current happening and isolation from the rest community of nations to mitigate the effect of the COVID pandemic. To achieve this hypothesis highlighted in this study, conventional and recent econometrics tools were adopted over annual time frequency from 1981-2014.

Assumed that COVID-19 significantly has reduced the concentration of emission in the atmosphere (Wang and Su 2020), the empirical estimation traces and validate cointegration relationship between, economic growth and pollutant emission (CO_2) all dimensions of globalization (social, economic and political) in China over sampled period. The long run regressions of DOLS, FMOLS, and CCR validate a positive and an inelastic relationship between economic growth and pollutant emission in China over examined period. This is

indicative to government officials of China, as this implies that, the Chinese economy is not responsive to dirty (CO_2) economic growth. This is seen in reduction of pollutant emissions in recent times because of less industrial activities that pollutes the environment (see Figure 1 for more insights into this argument). This position of carbon reduction admits COVID resonates the recent declaration by the report of Carbon Brief about the reduction of CO_2 emissions based on the decline in coal consumption.

Furthermore, the current study constructed twin models, where model two is the base line, which focuses on the isolation effect social and economic globalization on her economic growth in recent time. The regression indicates that the political willpower of the government administrators of china's economy to curb the wild spread of her health challenge that cut across the globe. This is clear in the positive and elastic effect of political wave of globalization to her economic growth. This suggests that despite the Chinese economy isolation from the rest of the world, her economy still experience a positive and significant growth trajectory (see Table 6). However, the more inclusive model displays significant impact of social and economic globalization on her economic growth. This outcome is also evident from the causality analysis as both economic and social globalization predicts pollutant emissions. This suggest that interaction with rest of the world has spillover effect on pollution emission. Interesting and novel in the current study isolation from rest of the world does not show any causality with pollutant emission. This results call for intensive policy mix for the country environment, as isolation from the rest of the world has its other implications, given the trade-off between economic growth and pollutant emissions, there is need for caution when liberalizing the economy, strong political willpower is needed to mitigate the adverse effect of globalization at all time.

Current database reflects a reduction in carbon emissions in China since the beginning of COVID-19 crisis, where recent strict measure put in place to ameliorate the spread of the virus at

both national and state level such as restriction on import, export and foreign trade in China and country boundaries. This is in line to curtail the spread of the pandemic. However, the laydown restrictions come with its already felt economic implications. Momentary each economic operates in isolation (closed) although not total as it is relaxed for palliatives and economic stimulant of which china is not exception

In line with IEA (2020) that assumes because of COVID-19 crisis estimated that economic growth for OECD countries in 2020 would be reduced by 0.5-2.4%. These projections are in line with the estimates obtained in our study, despite the fact that we are aware of the existence of gaps and limitations, mainly because it is still difficult to see the consequences, so at the close of this work the COVID-19 crisis is in full swing worldwide. With all this our study aims to establish a methodology that serves as a tool to advance the predictions on the economic impact of COVID-19, it will leave not only in China, but extensively, this methodology can be applied globally. Obtaining data on the reduction of emissions monthly allows us to adapt the growth forecasts according to the levels of CO_2, under a model that has considered the isolation that this crisis represents for the economic systems. On the other hand, the advance in this methodology is due to the fact that it takes into consideration the big economic blocks such as the EU, USA or India. On the other hand, it would also be useful to establish predictions at a local level, the levels of water pollution (PME) or the levels of NO_2 or GHG.

The current study is not void of policy direction for all stakeholders and the government administrator in China. The isolation of the Chinese economy from the rest of the world meet both conventional and health sense. This action is timely and worthwhile to help flatten the rise of the spread of COVID-19 and thereafter reduce the working and active (work force) population as results of infection from the virus. We observe that the willpower of the Chinese government is significant and there is no causality between political globalization and pollutant emission

against contract expectation where both social and economic globalizations engender CO_2 emissions. The current study employed the government of the day to sustain the current momentum.

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